Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
ReconRobotics Inc.,	)	
Request for Waiver of Part 90 of the	)	WP Docket No. 08-63
Commission's Rules to Provide for	)	
Limited Public Safety and Security	)	
Operations at 430-448 MHz	)	

Reply Comments of ReconRobotics Inc.

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ReconRobotics Inc. requested a waiver of Part 90 of the Commission's Rules to permit certification and customer licensing at 430-448 MHz of a small, remote-controlled, maneuverable surveillance robot for emergency use by state and local law enforcement and firefighting agencies, and by infrastructure security personnel in areas that may be too hazardous for human entry.[1] The company requested an outcome that permits it to certify the device and permits any eligible user to license the device, without further proceedings.

ReconRobotics here replies to the comments filed in the docket.

A. SUMMARY

The Recon Scout® provides an operator located a safe distance away with video and audio, along with infrared, biological, chemical, heat, radiation, or other needed data. The unit is small enough -- and strong enough -- to be dropped, launched, or thrown to where it is needed. Typical applications will include checking a building prior to forced entry; searching vehicle

[1] Request for Waiver of ReconRobotics Inc. (filed Jan. 11, 2008); *Wireless Telecommunications Bureau and Public Safety and Homeland Security Bureau Seek Comment on Request for Waiver by ReconRobotics, Inc. to Allow Certification and Use of Remote-Controlled Surveillance Robot Operating at 430-448 MHz,* WP Docket No. 08-63, DA 08-1077 (released May 6, 2008).

undercarriages for explosives; locating hostages, hostiles, officers, and bystanders before a rescue attempt; searching for survivors in a burning building; and inspecting the site of a chemical or nuclear release prior to sending in hazmat personnel.

Each Recon Scout unit uses one of three prioritized 6 MHz channels over 430-448 MHz at a power level of 1/4 Watt average (1 Watt peak). The waiver request proposed conditions to curtail any realistic possibility of harmful interference, including restrictions on customers and applications, imposition of secondary spectrum status, and yearly caps on quantities sold.

Many first responders filed in support of the waiver. Those who had tried the Recon Scout were universally enthusiastic about its potential to reduce risk to personnel. A typical comment: "This product will save lives by enabling us to get a clear view of an entire structure (corners, stairs, halls and rooms) before we have to put any of our officers in the line of fire."[2]

The only opposition came from amateur radio licensees and ARRL, The National Association for Amateur Radio.

The amateurs argue strenuously that ReconRobotics should use the 902-928 or 2400-2483.5 MHz unlicensed bands. We explained in the original Request for Waiver that the device cannot achieve adequate performance in those bands, due to inadequate building penetration. The Recon Scout can be remotely driven deep into a structure, or down a stairwell into a basement, so the signal may have to pass through multiple walls to reach the operator. Higher frequencies do not propagate as well through building materials as lower frequencies do. Satisfactory operation at 2.4 GHz, or even 902-928 MHz, would require higher power, resulting in batteries that are too big or a battery life that is too short. Bigger batteries in turn call for a

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[2] Rodney Tooley, Crosby, TX (supervisor of local law enforcement tactical unit).

bigger housing with more shock absorption, resulting in a unit that is too large and heavy to throw.[3] ReconRobotics reluctantly concluded that a workable unit must use frequencies below about 450 MHz.

ARRL argues that the requested waiver would violate the Table of Allocations, and requires a rulemaking to amend the table. But there is an existing allocation for non-Government (Part 90) radiolocation, which operates at powers far higher than ReconRobotics proposes. We seek a waiver of those rules under the existing allocation.

The amateurs argue that a Recon Scout in use during an emergency will cause harmful interference to amateur operators assisting with the emergency, or that the amateurs will cause harmful interference to the Recon Scout. The first is unlikely; the kind of short-term emergencies that need a Recon Scout will not ordinarily need amateur assistance. The second, if it occurs, is not the amateurs' responsibility. ReconRobotics proposes to operate on a secondary basis to all licensed services, and to accept interference from any licensed user.

The amateurs fear interference into their satellite operations. But the geometrical relationship among satellites, earth stations, and Recon Scout operations makes such interference astronomically unlikely.

Finally, ARRL cites a prior Bureau denial of a waiver as precedent, even though the grounds for decision in that case are inapplicable here.

The very high public interest in the device, together with the very low likelihood of harmful interference into other services, fully justify a grant of the waiver.

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[3] See Part C.2 below for details.

B. COMMENTS IN SUPPORT

More than thirty first responders, organizations, and representatives filed in support of the waiver.[4] It is unusual for so many busy emergency personnel to take the trouble to navigate their way through the FCC website.

Their comments collectively stressed the potential of the Recon Scout to save lives. Several mentioned its unique abilities and superior performance over competing technologies. Some particularly emphasized the importance of maneuverability, and the need for operation deep inside buildings. A few gave numerical estimates of the needed operating ranges, typically running to hundreds of feet.

This is a sampling of excerpts from the filed comments:

- "The Recon Scout is number one on the list of life saving tools that we introduced this year."[5]
- "The Recon Scout allows us to direct the visual observation of an area, rather than placing a fixed camera and being limited to what we can see before entering the hazardous area. . . . It will save lives."[6]
- "I have not seen such a smart and easy to use product that provides intelligence to law enforcement officers from a safe distance. . . . Currently, there is no product like the Recon Scout available to law enforcement and because of this, they must put themselves in harm's way to breach buildings and save lives."[7]

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[4] Some of the comments describe field trials with the Recon Scout. These were conducted under an experimental license.

[5] Heath Fleener, Police Officer, Ludlow Police Dept., Ludlow, IL.

[6] Kurt Ashley, Gilroy Police Department, Gilroy, CA.

[7] Michael Asimor, Saint Charles, IL (consultant in Homeland Security products and services).

- "[A] great tool for those of us in the Tactical Law Enforcement community. . . The size makes it easy to carry and deploy and can be easily operated by one officer."[8]

- "I have used the Recon Scout robot to clear rooms in tactical situations. Its innovative design actually saved lives. . . . To my knowledge, there is no adequate alternative technology."[9]

- "This tool would help keep our officers safe before making entry so we would know what was going on. . . . It the best tool I have seen on the market for law enforcement."[10]

- "This equipment would greatly enhance the overall safety of our officers by being able to send the Scout into a hostile environment before the officer."[11]

- "The Recon Scout is the perfect item to aid in rapid deployment of personnel. . . . [I]ts size (or lack thereof), mobility and visual capabilities makes it far more feasible than its closest competitor."[12]

- "The use of a maneuverable tool like the Scout saves us from putting officers and service dogs lives at risk unnecessarily."[13]

- "[The Recon Scout] allows for the safe clearing of buildings during a critical incident without placing operators in harm's way. This greatly reduces the risk of injury to officers and suspects."[14]

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[8] Sgt. Willard F. Cragun, Ogden Police Department Metro S.W.A.T., Ogden, UT.

[9] Casey Hoyer, Albany, OR (former law enforcement officer serving the U.S. government in a military capacity).

[10] Robert Ward, Norwood, OH (member of local SWAT team).

[11] Kames Morehead, Sergeant, West Chester Police Dept., West Chester, PA.

[12] Virginia State Police, Technical Services Unit, Richmond, VA.

[13] Lt. Sanford S. Levy, SWAT/EHDD Commander, Tucson Police Department, Tucson, AZ.

[14] Detective Scott Gottesman, Albany Police Department Emergency Service Team (SWAT), Albany, NY.

- "Currently this is the best technology available."[15]
- "We don't feel comfortable without this thing now."[16]

C. RESPONSE TO OPPOSITION

The only opposition to the waiver request came from ARRL and amateur licensees. The ARRL filing raises a large number of points, none of which constitutes a serious challenge to the waiver request. The substance of the individual filings mostly echo ARRL.[17]

1. Allocation issue

ARRL argues there is no domestic allocation at 430-450 MHz specifically for public safety land mobile services.[18] We agree. ARRL argues further that a waiver would violate the allocation tables in Section 2.106, and so requires an allocation proceeding.[19] That is incorrect. As ARRL concedes, there is a non-federal allocation for radiolocation under Part 90.[20] ReconRobotics made clear from the first page of its request that it seeks a waiver of those Part 90 rules.

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[15] Philip Harris, Municipal Police Department, Homestead, FL.

[16] Darin E. Logue, Special Agent, Mid Missouri Drug Task Force.

[17] A few amateurs filed to support the waiver. Jerome M. Kutche N9LYA; Chris J. Smith K1CJS (does not oppose in life-threatening applications).

[18] ARRL at 2.

[19] ARRL at 2-3.

[20] ARRL at 2 n.1.

ARRL then claims that the Part 90 radiolocation rules limit operation in the band to N0N (radar) emissions.[21] That is simply wrong.[22] But even if right, it would not be an argument against the waiver. "It is manifest error to deny a waiver on the ground that there would be a violation in the absence of the waiver sought."[23]

Separately, ARRL urges an allocation rulemaking on the ground that a waiver would unfairly benefit ReconRobotics to the exclusion of other manufacturers.[24] But that argument would eliminate all equipment waivers, regardless of merit, contrary to settled law.[25] Moreover, the Commission has traditionally granted "me-too" waivers to competitors of a waiver recipient. ReconRobotics will not oppose requests for me-too waivers, nor would it oppose a Commission announcement of intent to grant them.[26]

2. Choice of band

ARRL devotes much of its comment to arguing that ReconRobotics should use the 902-928 MHz or 2.4 GHz unlicensed bands, rather than 430-448 MHz. Noting that ReconRobotics

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[21] ARRL at 2 n.1.

[22] "For radiolocation operations as may be authorized in accordance with subpart F, unless otherwise provided for any type of emission may be authorized upon a satisfactory showing of need." 47 C.F.R. Sec. 90.207(k).

[23] *WAIT Radio v. FCC*, 418 F.2d 1153, 1158 n.12 (D.C. Cir. 1969). *See also id*., 418 F.2 at 1158 ("The very essence of waiver is the assumed validity of the general rule, and also the applicant's violation unless waiver is granted.")

[24] ARRL at 3.

[25] *WAIT Radio v. FCC*, 418 F.2d at 1157 (requiring agency to consider "application for exemption based on special circumstances").

[26] *See, e.g., Spread Spectrum Devices*, 16 FCC Rcd 10036 at para. 26 (2001) (granting waiver request for a digital modulation device and inviting others).

designed a version of the Recon Scout for the U.S. military in the 420-450 MHz band, ARRL suggests ReconRobotics picked the same band for non-military units to avoid the cost of re-engineering the product.[27]

We wish this were true. The costs of prosecuting the waiver -- and especially the loss of revenue during its pendency -- far exceed the costs of re-engineering. As a business matter, ReconRobotics would much prefer to use 2.4 GHz, file a me-too request on the *Remington Arms* waiver,[28] and put the product on the market.

As a technical matter, however, that option is not available. The fundamentals of radio propagation dictate that building materials present more of an obstacle to higher frequencies than to lower frequencies. Performance overseas has been very successful at 420-450 MHz. ReconRobotics had originally expected to manufacture the non-military version at 902-928 MHz or 2.4 GHz, as ARRL suggests. But extensive modeling and field testing showed that building penetration is inadequate at these frequencies, at the 0.25 W average power proposed. As the Recon Scout maneuvers deeper into a building, officers on the scene would have to move in dangerously close in order to keep the signal, and would risk losing contact entirely.

In principle the company could make up for the higher building attenuation at 902-928 MHz or 2.4 GHz by increasing transmitter power. As in any well-engineered product, however, changes to one characteristic inevitably affect others. An increase in power, assuming the present one-hour battery life is maintained, would require bigger and heavier batteries. Those in

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[27] ARRL at 4-6.

[28] *Remington Arms Company*, 20 FCC Rcd 18724 (2005) (granting waiver to authorize analog video modulation at power levels that ordinarily require digital modulation).

turn would require more shock absorption in a bigger and heavier housing. The result would be an oversize, overweight package incapable of being thrown a useful distance.[29]

ARRL tries to equate the Recon Scout with the surveillance devices manufactured by Remington Arms Company and by Octatron & Chang, which operate at 2.4 GHz and 902-928 MHz, respectively.[30] But there is an important difference: the cited devices are not maneuverable. The Remington "Eyeball" and the Octatron & Chang "Dragon Egg" transmit from wherever they happen to land; the Octatron & Chang "Pole Camera" transmits from the top of a hand-carried pole. If tossed into a window, these devices might have to penetrate one layer of building material at most. The Recon Scout, in contrast, can be (and often must be) remotely

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[29] ***Technical details***. The existing robot has 60 minutes of battery life, weighs 0.54 kg, and fits in a bounding volume of 1050 cm^3. Operational distance is approximately 90 m line-of-sight and 30 m non-line-of-sight. The unit withstands repeated drops from 9 m onto concrete.

The following calculations assume that battery life, operating distance, and shock resistance remain unchanged. Using the 902-928 MHz band would cut the received field strength at the edge of the useful range by approximately 6 dB, requiring an increase in transmitter power by a factor of 4. The needed battery would increase the total weight to 0.78 kg and the overall bounding volume to 2180 cm^3. The 2.4 GHz version is much worse. It costs 15 dB difference in signal strength, requiring a 30-fold increase in transmitter power. The weight goes to 1.96 kg (more than triple the current model) and volume becomes 5450 cm^3 (five times the current model).

[30] ARRL at 5-6. See *Remington Arms Company, supra*; *Office of Engineering and Technology Declares Octatron, Inc. and Chang Industry, Inc. Request for a Waiver of Part 15 to Be a "Permit-but-Disclose" Proceeding for Ex Parte Purposes*, DA 05-3339 (Office of Engineering and Technology released Dec. 29, 2005). The Commission recently transferred the *Remington Arms* waiver to another company. *ODF Optronics, Ltd.*, DA 08-941 (released April 23, 2008).

steered deep into a building, sometimes below ground level. Several of the first responders who support the waiver are very specific on the need to penetrate deep into buildings.[31]

Some individual amateurs urge ReconRobotics to use "white space" TV channels.[32] This is not practicable. The Commission has not approved mobile devices in white space frequencies, and at this writing, the technology for preventing interference to TV reception remains unproven.

In short, adequate performance requires frequencies below about 450 MHz. For the reasons set out in the Request for Waiver, ReconRobotics believes it can operate at 430-448 MHz without causing harmful interference to other users.

3. Interference with emergency communications

ARRL and some individual licensees fear that amateurs conducting emergency communications in support of first responders who use the Recon Scout will be subject to interference from the Recon Scout.[33]

The nation's amateurs have long provided invaluable service in emergencies, especially those that disrupt normal communications such as floods, earthquakes, hurricanes, and wildfires. But the emergencies that will benefit from the Recon Scout are of a different kind. These

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[31] *E.g.*, "The Recon Scout should operate at a distance of 100-200 feet inside a building and 300-400 feet outside . . . ." Heath Fleener, Police Officer, Ludlow Police Dept., Ludlow, IL. "Minimum operational requirements would need to be 100 feet indoors and 300 feet outdoors." Donn Kraemer, President, Rocky Mountain Tactical Team Association, Lakewood, CO. "[T]he robot must be able to cross long distances and/or in structures which contain heavy concrete walls or steel." Sgt. Bob Gembara #4608, DesPlaines, IL (State Police Tactical Response Team). "We need the penetration ability to watch and control the unit from a safe distance." Sacramento County Sheriff's Department, Sacramento, CA. "Good building penetration is needed for officer safety and alternative technologies are not satisfactory." Ron Swanson, Glendale, AZ (law enforcement officer).

[32] *E.g.* David M. Aronovitz K1LPI.

[33] ARRL at 8-9; Chris J. Smith K1CJS.

include such short-term needs as surveilling a sniper, locating a hostage, searching for survivors in an ongoing fire, or inspecting a chemical or nuclear release. The Recon Scout battery life is only one hour. In most instances, an emergency using the device will be brief in duration and will not require amateur assistance. Conversely, the kinds of catastrophes that depend on amateur communications will rarely, if ever, use the Recon Scout.

ARRL and some amateurs also express concern about interference during emergency operations in the reverse direction, from amateur transmitters into the Recon Scout receiver.[34] Some fear they will be held responsible for disrupting emergency operations.[35]

ReconRobotics specifically proposes operation secondary to the Amateur Radio Service.[36] A Recon Scout user will have no right to complain about incoming interference from amateur operations. In any event, interference will take the form of disruption to video. The Recon Scout operator will have no way to identify the source of the interference, and no reason to try.

4. Satellite interference issues

ARRL calls ReconRobotics "startlingly naive and mistaken" in saying that amateur satellite receivers usually operate well above the horizontal.[37] We stand by our point. An amateur satellite, being non-geosynchronous, appears to move across the sky. Relative to a

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[34] ARRL at 8-9; Rex G. Carr AA1KL; Lee A. Hodges KC8ITI

[35] *E.g.*, Mike Watkins WX4AL.

[36] Request for Waiver at 15.

[37] ARRL at 7.

given point on the earth's surface, it necessarily spends most of its time well above (or well below) the horizon. The satellite transits the horizon only as it rises or sets.[38]

For a Recon Scout to interfere with satellite reception, the unit would have to lie very nearly on the straight line between the receiving antenna and the satellite. Considering the very limited number of Recon Scouts proposed, and the infrequent operation of each, the probability is vanishingly small that an amateur licensee attempting near-horizontal reception would ever happen to aim directly at an operating Recon Scout.

Moreover, the Recon Scout can used only on the ground or in a building. Interference could occur only if the receiver attempted to acquire a satellite not only very close to the horizon, but also through the ground clutter and/or buildings where the Recon Scout is located. These conditions give rise to interference from multiple noise sources such as vehicle ignitions, electric motors, etc., along with atmospheric problems. Even in the absence of a Recon Scout, those factors all but rule out reliable communications. Reception at very low angles will succeed only if the horizon is largely empty, as across an open field. But an open field has no place for a Recon Scout.

Taking these factors together, it is all but impossible that the Recon Scout would make the difference between successful and und unsuccessful satellite reception.

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[38] If the orbital path makes a small angle with the horizon (as seen from the reception point), the satellite will spend more time near the horizon, but a proportionately longer time at higher angles.

5. Inapplicability of Terry Mahn, Esquire

ARRL cites the Bureau decision in *Terry Mahn, Esquire* as precedent for denying the ReconRobotics request.[39] In fact, however, the only element in common between that case and this one is the frequency band.

The applicant in *Terry Mahn* sought to operate a positioning system at 433.92 MHz, having chosen that frequency to harmonize with European operation.[40] The device did not comply with the Part 15 power and duty cycle limitations,[41] and did not meet the frequency stability requirements for Part 90 radiolocation.[42]

The Commission stated three grounds for denying a Part 90 waiver, none of which applies here.

First, the Commission noted that a grant in *Terry Mahn* would have given the applicant primary status and increased its interference protection.[43] Here, in contrast, ReconRobotics specifically proposes operation "secondary to Federal users, secondary to the Amateur Radio Service, and on a co-equal basis with other non-Federal users."[44] ReconRobotics emphasized

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[39] ARRL at 3, *citing Terry Mahn, Esquire*, DA 06-2501 (Wireless Telecommunications Bur. released Dec. 13, 2006).

[40] *Terry Mahn* at 1.

[41] *Terry Mahn* at 1; 47 C.F.R. Sec. 15.231.

[42] *Terry Mahn* at 2; 47 C.F.R. Sec. 90.213(a) (table).

[43] *Terry Mahn* at 3.

[44] Request for Waiver at 15.

that "does not seek interference protection from any licensed user."[45] Grant of the waiver would not result in enhanced protection status.

Second, said the Commission, the applicant in *Terry Mahn* did not show why other frequencies are unsuitable.[46] The only reason given was harmonization, which in turn appears to rest on cost considerations.[47] Here, the need for adequate building penetration rules out the Part 15 spread spectrum bands.[48] The request for the 420-450 MHz band rests on performance considerations, not cost.[49]

Third, the applicant in *Terry Mahn* sought to invoke a prior precedent by incorrectly equating a 25 percent difference in output power with a 600 percent variation in frequency stability.[50] ReconRobotics has done nothing similar.

In short, the considerations that led to denial in *Terry Mahn* are not present here.

CONCLUSION

The spectrum below 40 GHz is full. Every band is spoken for. Most have multiple allocations. The 700 MHz auction aroused great interest not only due to the band's favorable propagation characteristics, but also because the auction winners will move into empty spectrum.

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45 *Id*.

46 *Terry Mahn* at 3.

47 *Terry Mahn* at 1, 3.

48 Request for Waiver at 7-9. See also Part C.2, above.

49 Cost considerations (along with performance issues such as signal drop-off) dictate the use of analog rather than digital modulation, but have no bearing on choice of frequency band. *See* Request for Waver at 7 n.4.

50 *Terry Mahn* at 4.

Those may be the last vacant frequencies ever to become available, below the millimeter-wave bands.

Yet innovation goes on. New needs for radio-based technologies continue to appear, as do new technologies to meet those needs. With no blank spaces in the allocation table, a new technology must either share spectrum with existing users, or displace and relocate existing users. (Even relocation does not eliminate the sharing problem, but merely shifts it to elsewhere in the spectrum.)

The amateurs who filed comments are understandably wary of other users coming into their band. They are not alone. A host of Commission proceedings address the problem of fitting more and more services and users into a limited amount of spectrum. But the Commission has generally found that adding new services to a band is justified if two conditions are met: high public interest in the new technology, and low likelihood of significant disruption to incumbents. To deny sharing in any band that is occupied would freeze radio-based technology at its present level, in violation of the Commission's public interest mandates.[51] Those mandates fully support the Commission's adding new users to a band, subject to appropriate conditions that minimize the probability and the magnitude of interference.

Public interest in the Recon Scout is not open to serious question. The conditions proposed by ReconRobotics, together with the low power of the Recon Scout and the short-term,

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[51] "[T]he Commission from time to time, as public convenience, interest, or necessity require, shall-- . . . generally encourage the larger and more effective use of radio in the public interest[] . . . ." 47 U.S.C. Sec. 303(g). "It shall be the policy of the United States to encourage the provision of new technologies and services to the public." 47 U.S.C. Sec. 157(a).

emergency-only nature of its operation, will make interference rare, and if it occurs at all, minor and brief.

The Commission should grant the waiver.

Respectfully submitted,

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June 6, 2008

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